PATENT APPLICATION TRANSMITTAL LETTER
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Docket No.
INTL-0258-US (P7494)

TO THE ASSISTANT COMMISSIONER FOR PATENTS

Transmitted herewith for filing under 35 U.S.C. 111 and 37 C.F.R. 1.53 is the patent application of:

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For: **CONTROLLING PROCESSOR-BASED SYSTEMS USING A DIGITAL CAMERA**

Enclosed are:

- ☒ Certificate of Mailing with Express Mail Mailing Label No. **EL515088815US**
- ☒ **Five (5)** sheets of drawings.
- ☐ A certified copy of a application.
- ☒ Declaration ☒ Signed. ☐ Unsigned.
- ☒ Power of Attorney
- ☐ Information Disclosure Statement
- ☐ Preliminary Amendment
- ☒ Other: **Recordation Form Cover Sheet, Assignment and check for $40**

CLAIMS AS FILED

For	#Filed	#Allowed	#Extra		Rate	Fee
Total Claims	30	- 20 =	10	x	$18.00	$180.00
Indep. Claims	5	- 3 =	2	x	$78.00	$156.00
Multiple Dependent Claims (check if applicable) ☐						$0.00
					BASIC FEE	$760.00
					TOTAL FILING FEE	$1,096.00

- ☒ A check in the amount of **$1,096.00** to cover the filing fee is enclosed.
- ☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. **20-1504** as described below. A duplicate copy of this sheet is enclosed.
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Dated: **October 29, 1999**

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INTL-0258-US
(P7494)

APPLICATION

FOR

UNITED STATES LETTERS PATENT

TITLE: CONTROLLING PROCESSOR-BASED SYSTEMS USING A DIGITAL CAMERA

INVENTORS: FREDERICK J. COOPER, RANJIT R. MENON, TERESA L. URUTIA, GIRISH GOPAL, KEITH E. HOPPER and BLAKE R. BENDER

Express Mail No.: EL515088815US

Date: October 29, 1999

CONTROLLING PROCESSOR-BASED SYSTEMS USING A DIGITAL CAMERA

Background

This invention relates generally to processor-based systems and particularly to such systems which have a digital camera coupled to the system.

A variety of processor-based systems come with a digital camera or are adaptable to be coupled to a digital camera. Commonly, digital cameras are tethered through an appropriate input port to personal computers. A number of users operate the digital cameras continuously through a tethered connection to the computer.

The camera may be maintained always "on", ready to provide a useful service as the opportunity arises. The camera may be used to implement a video conferencing feature or to stream video over the Internet as examples.

A number of techniques are available for controlling processor-based systems. Processor-based systems may receive input commands using a mouse which is tethered to the computer, using an infrared mouse which controls the computer remotely, using a variety of remote control devices, and using keyboards either tethered to the computer or keyboards that are coupled to the computer through infrared or other airwave communications, as a few examples.

In addition, a number of computer systems transition between power consumption states in response to periods of sustained user inactivity. That is, if the keyboard, for example, is not operated for a given time period, the system may transition to a lower power consumption state. With ensuing periods of inactivity, the system may progressively transition to even lower power consumption states. In this way, the amount of power that the system consumes may be controlled. In addition to environmental advantages, the lifetime of the computer may be enhanced by such powering down in response to inactivity.

Sensors may detect the user's presence in proximity to the keyboard. These sensors may be piezoelectric sensors that detect when the user is poised over the keyboard, for example. Again, this type of sensor provides additional information to the computer system to make a judgment about whether or not to transition to lower power consumption modes. If the user is poised over the keyboard about to operate the keyboard, it makes no sense to transition to a lower power consumption mode only to immediately transition back to a higher power consumption mode. Not only is this awkward, but needless transitions waste time and system resources.

Thus, there is a continuing need for better ways to control the power consumption of computer systems.

Summary

In accordance with one aspect, a method of controlling a processor-based system includes receiving video information from a camera. The power consumption state of the system is controlled based on the video information.

Other aspects are set forth in the accompanying detailed description and claims.

Brief Description of the Drawings

Fig. 1 is a front elevational view of a processor-based system in accordance with one embodiment of the present invention;

Fig. 2 is a flow chart for software for implementing one aspect of one embodiment of the present invention;

Fig. 3 is a flow chart for software for implementing another aspect of one embodiment of the present invention;

Fig. 4 is a flow chart for software for implementing another aspect of one embodiment of the present invention;

Fig. 5 is a flow chart for software that implements another aspect of one embodiment of the present invention; and

Fig. 6 is a block diagram for the embodiment shown in Fig. 1.

Detailed Description

A processor-based system 10 shown in Fig. 1, includes a processor-based housing 12, a keyboard 13, a display 14

and a digital camera 16 which may be coupled by a tether (not shown) to the housing 12. As illustrated, the camera 16 is positioned to observe the area in front of the processor-based system 10. Thus, the camera 16 detects the user's presence as well as the lighting conditions proximate to the system 10.

Referring now to Fig. 2, light monitoring software 18 stored on the system 10, is responsible for controlling the power consumption state of the processor-based system 10 in response to ambient light. A timer is reset (block 20) and the keyboard and mouse are checked for their current condition (block 22). At diamond 24, a check determines whether the keyboard and mouse have just been used. If so, the timer is again reset. If not, the check at diamond 26 determines whether the timer has expired. If the timer has expired, indicating a period of inactivity exceeding a predetermined time period, a video frame is grabbed as indicated in block 28. In other words, the camera 16 provides a video frame which may be analyzed at block 30. In particular, the luminance value of the frame may be computed at block 30.

A subsampling of the pixels of a frame may be analyzed, for example, approximately 250 pixels in one embodiment of the invention, evenly distributed throughout the frame. Each pixel's luminance value is computed by converting its red, green, blue (RGB) color space value to a hue, saturation and luminance (HSL) color space value

using well known techniques. Luminance is the brightness portion of a composite video signal. The pixel luminance values are simply summed and divided by the number of samples. The result is the return luminance value.

Referring to Fig. 3, the software 42 for determining the return luminance value begins by taking the video frame as described previously (see block 44). The pixel stepping for the pre-set sample set, approximately 250 pixel samples in this example, is computed (block 46). The software steps to the next pixel location (block 48). The pixel at the next location has its RGB color space values converted to an HSL format (blocks 50 and 52). The luminance value of the next pixel (from the HSL space) is added to the accumulated luminance total value, as indicated in block 54. If there are more pixels to complete the sample set, the flow iterates. If not, the luminance total is divided by the number of pixel samples as indicated in block 58. The result is then returned to the flow in Fig. 2, as indicated at block 60.

Returning to Fig. 2, next the motion value is computed (block 32). As shown in Fig. 4, software 62 for computing the return motion value begins by taking the video frames from the previous steps (Fig. 2) as indicated at block 64. The pixel stepping for a pre-set number of pixels, for example approximately 250 pixels, is computed, as indicated in block 66. The flow steps through each successive pixel as indicated in block 68. At block 70, the pixel at the

new location in the old frame and new frame are accessed. The red value in the old frame is subtracted from the red value in the new frame and this process is repeated for the blue and green values as indicated in block 72. An absolute value of the difference is computed (block 74).

If the result is greater than 50 or some other noise threshold (diamond 76), the result is added to the total motion return value (block 78). At diamond 80 a determination is made as to whether there are additional pixels in the initial set of 250 pixel samples. If not, the motion value is returned (block 82). Otherwise, the flow continues to iterate until all the pixels in the sample have been processed.

Returning again to Fig. 2, at diamond 34 the flow determines whether the returned luminance value differs by more than 40 percent. Of course, 40 percent is merely an exemplary threshold for testing the returned luminance value. If so, a check at diamond 36 determines whether this is the fourth time (or some other number) in a row that the luminance value remained at this level. If so, a check at diamond 38 determines whether motion has occurred during the time period. If not, appropriate changes can be made as indicated in block 40. Among the changes that may be made are to activate a screen saver, implement a power management decision or implement a system utility.

Once the camera 16 is activated, it may capture a frame every second in one embodiment of the invention. The

system 10 computes the luminance value for each frame and compares its value to the luminance value computed for a previous frame. If the number is significantly lower than that of previous frames, the software starts to suspect the lights might be out. It keeps capturing frames, computing both a luminance value and a motion value. If the luminance value continues to be low for several frames and the motion value is also low, the computer screen saver and power management mode may be activated. When full power management is turned on, a keyboard or mouse input signal may be used to reactivate the computer. However, the camera 16 can continue to run with the monitors, printers and hard drives powered down, as long as the processor remains on.

The camera continues to capture frames while the computer is in the lower power usage mode or screen saver mode. It compares the frames and computes the luminance value for each frame. If the luminance suddenly increases, the system is immediately returned to full power status and/or the screen saver is deactivated. If the luminance values do not change significantly, and motion occurs for a time period (for example continuously for three seconds), the system may be returned to full power status and/or the screen saver may be deactivated.

Turning now to Fig. 5, the software 84 for leaving the screen saver, power management, or system utility modes begins by checking the keyboard and mouse status (block

86). At diamond 88, a check determines whether the keyboard or mouse was just used. If so, the computer is returned to full operational status as indicated in block 102. The timer is reset, as indicated in block 104, and the keyboard and mouse states are checked (block 106).

At diamond 108, a check determines whether the keyboard or mouse were just used. If not, the flow determines (at diamond 110) whether the timer has expired. If so, the screen saver, power management mode or system utilities may be reactivated, as indicated in block 112. Otherwise, the system continues to check the keyboard and mouse state, as indicated in block 106.

If the keyboard and mouse were not used as determined at diamond 88, a video frame is grabbed as shown in block 90. A luminance value and motion value are computed as indicated in blocks 92 and 94. If the luminance value does not differ by a preset amount (for example more than 40% at diamond 96), a check at diamond 98 determines whether motion has occurred. If so, a check at diamond 100 determines whether motion has occurred two times in a row. If so, the system returns to full activation (block 102). If not, the flow returns to block 86 and checks keyboard and mouse states.

Referring now to Fig. 6, the system 10 may include a processor 114 coupled to an interface 116. The interface 116 may be a chipset or bridge, as two examples. The interface 116 may be coupled system memory 118 and a

display controller 122. The display controller is coupled to the display 14.

The interface 116 may also couple a bus 126. The bus 126 in turn may be coupled through an interface 128 to the camera 16. In addition, the bus 126 may couple an interface 132. The interface 132 may be coupled to a bus 136 and to a storage device such as a hard disk drive 134. The software 18, 42, 62 and 84 may be stored on the hard disk drive 134.

The bus 136 is coupled to conventional components such as a serial input/output device 138. The device 138 couples a mouse 142 and a keyboard 13. The basic input/output system (BIOS) 144 may also be provided on the bus 136.

While the present invention has been described with respect to a limited number of embodiments, those skilled in the art will appreciate numerous modifications and variations therefrom. It is intended that the appended claims cover all such modifications and variations as fall within the true spirit and scope of this present invention.

What is claimed is:

1. A method of controlling a processor-based system comprising:

receiving video information from a camera;

analyzing said information; and

controlling the power consumption state of said system based on said video information.

2. The method of claim 1 further controlling the operation of system utilities based on said video information.

3. The method of claim 1 further controlling the operation of a screen saver based on said information.

4. The method of claim 1 wherein analyzing said information includes calculating a luminance value from said video information.

5. The method of claim 4 including determining whether said luminance value has changed by a given amount.

6. The method of claim 5 including determining whether the luminance value has changed by a given amount for a given time period.

7. The method of claim 4 including determining a value indicative of whether the video information indicates motion.

8. The method of claim 7 including determining whether said motion has persisted for a given period of time.

9. The method of claim 8 including using said value to control the power consumption state of said system.

10. An article comprising a medium for storing instructions that cause a processor-based system to:

analyze video information; and

control the power consumption state of said system based on said video information.

11. The article of claim 10 further storing instructions that cause a processor-based system to control the operation of system utilities based on said video information.

12. The article of claim 10 further storing instructions that cause a processor-based system to control the operation of a screen saver based on said information.

13. The article of claim 10 further storing instructions that cause a processor-based system to calculate a luminance value from said video information and to use said luminance value to control the power consumption state of said system.

14. The article of claim 13 further storing instructions that cause a processor-based system to determine whether said luminance value has changed by a given amount.

15. The article of claim 14 further storing instructions that cause a processor-based system to determine whether the luminance value has changed by a given amount for a given time period.

16. The article of claim 14 further storing instructions that cause a processor-based system to determine a value indicative of whether the video information indicates motion.

17. The article of claim 16 further storing instructions that cause a processor-based system to determine whether said motion has persisted for a given period of time.

18. The article of claim 17 further storing instructions that cause a processor-based system to use said motion information to control the power consumption state of said system.

19. The article of claim 10 further storing instructions that cause a processor-based system to determine whether the lights are on proximate to the system.

20. A method of controlling a processor-based system comprising:

receiving video information;

analyzing said information to develop luminance information; and

controlling the operation of software on said system based on said luminance information.

21. The method of claim 20 further including controlling the power consumption state of said system based on said luminance information.

22. The method of claim 20 further including controlling the operation of a screen saver based on said luminance information.

23. The method of claim 20 further including controlling the operation of system utilities based on said luminance information.

24. The method of claim 24 including determining whether the video information indicates motion.

25. An article comprising a medium for storing instructions that cause a processor-based system to:

analyze video information to develop luminance information; and

control the operation of software on said system based on said luminance information.

26. The article of claim 25 further storing instructions that cause a processor-based system to control one or more of the power consumption state of said system, a screen saver, or system utilities, based on said luminance information.

27. The article of claim 26 further storing instructions that cause a processor-based system to determine whether the video information indicates motion.

28. A processor-based system comprising:

a processor, said processor coupled to a storage device;

a digital camera coupled to said processor; and

said storage device storing software that controls the power consumption state of said system based on information received from said camera.

29. The system of claim 28 wherein said software controls the power consumption state of said system based on information from said camera indicative of motion proximate to said camera.

30. The system of claim 28 wherein said software controls the operation of system utilities based on information from said digital camera.

CONTROLLING PROCESSOR-BASED
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Abstract of the Disclosure

A processor-based system may be controlled using a digital camera. The digital camera can provide luminance and motion information which may be analyzed to determine whether to alter one or more of the power consumption state, the operation of system utilities, or the operation of a screen saver.

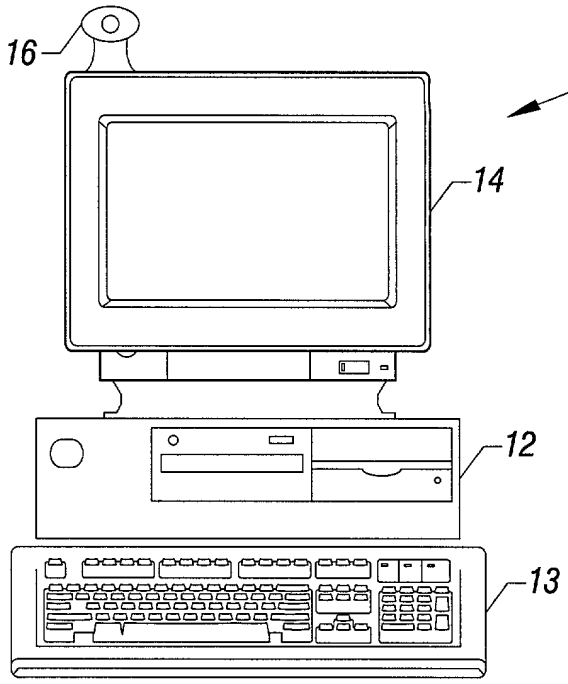
16
10
14
12
13

FIG. 1

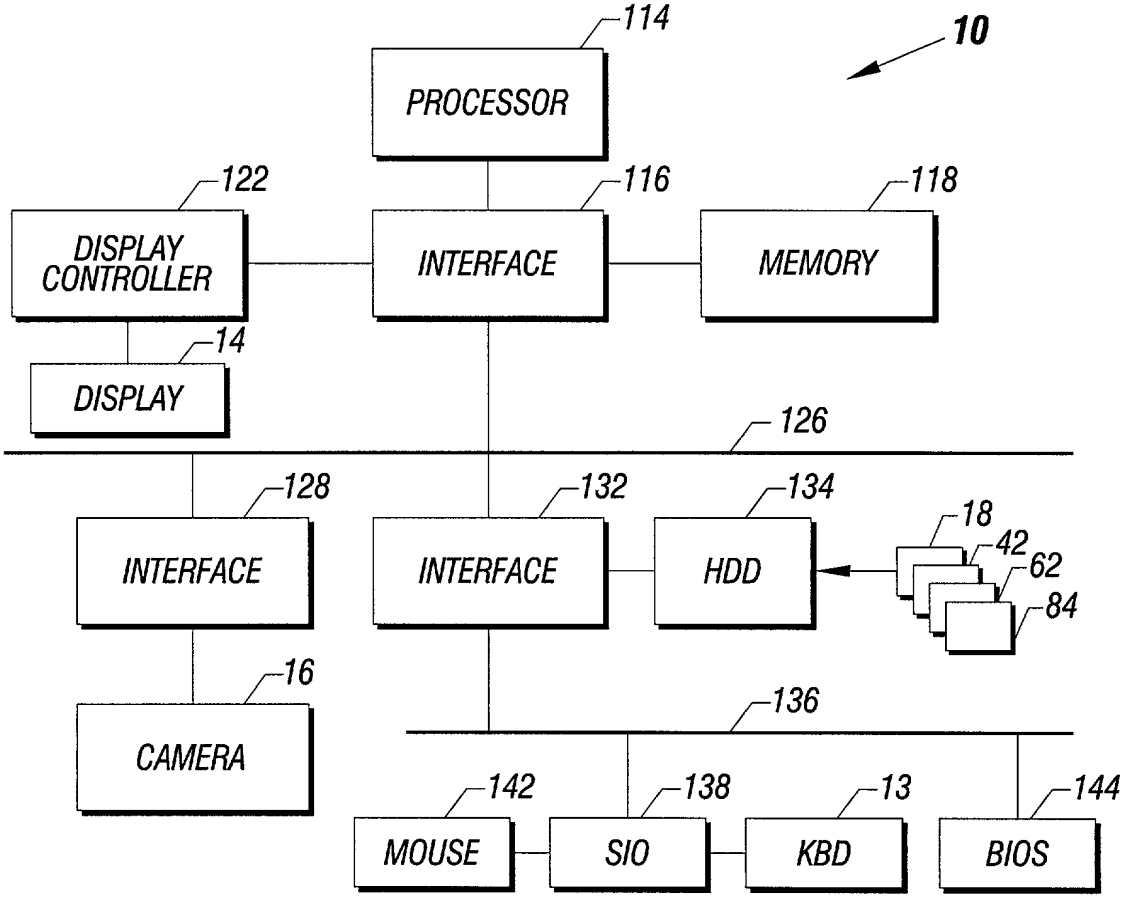
10
114
PROCESSOR
122
116
118
DISPLAY CONTROLLER
INTERFACE
MEMORY
14
DISPLAY
126
128
132
134
18
42
62
84
INTERFACE
INTERFACE
HDD
16
CAMERA
136
142
138
13
144
MOUSE
SIO
KBD
BIOS

FIG. 6

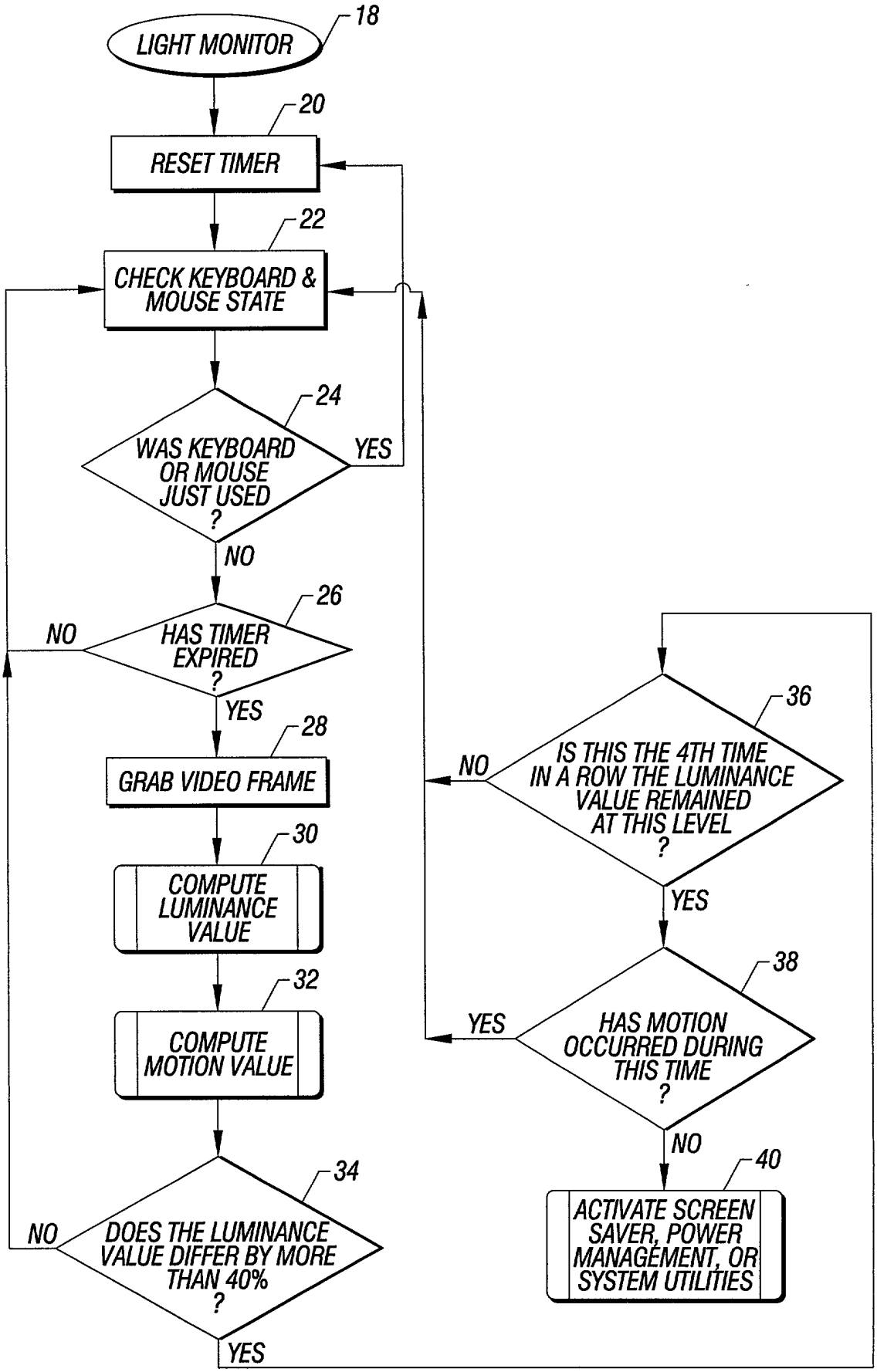
LIGHT MONITOR
18
RESET TIMER
20
CHECK KEYBOARD & MOUSE STATE
22
WAS KEYBOARD OR MOUSE JUST USED ?
24
YES
NO
HAS TIMER EXPIRED ?
26
NO
YES
GRAB VIDEO FRAME
28
COMPUTE LUMINANCE VALUE
30
COMPUTE MOTION VALUE
32
DOES THE LUMINANCE VALUE DIFFER BY MORE THAN 40% ?
34
NO
YES
IS THIS THE 4TH TIME IN A ROW THE LUMINANCE VALUE REMAINED AT THIS LEVEL ?
36
NO
YES
HAS MOTION OCCURRED DURING THIS TIME ?
38
YES
NO
ACTIVATE SCREEN SAVER, POWER MANAGEMENT, OR SYSTEM UTILITIES
40

FIG. 2

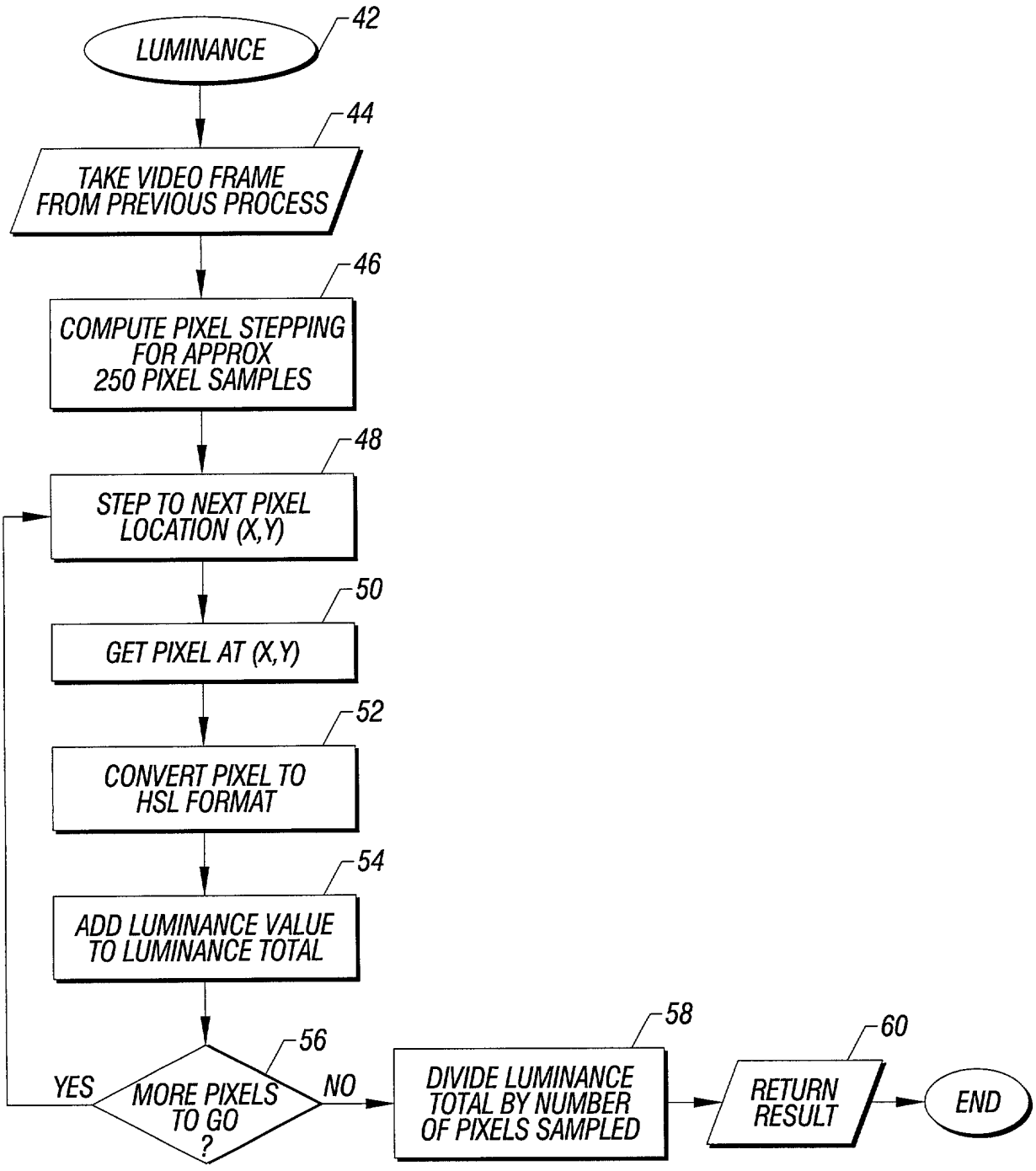
LUMINANCE
42
TAKE VIDEO FRAME FROM PREVIOUS PROCESS
44
COMPUTE PIXEL STEPPING FOR APPROX 250 PIXEL SAMPLES
46
STEP TO NEXT PIXEL LOCATION (X,Y)
48
GET PIXEL AT (X,Y)
50
CONVERT PIXEL TO HSL FORMAT
52
ADD LUMINANCE VALUE TO LUMINANCE TOTAL
54
MORE PIXELS TO GO ?
56
YES
NO
DIVIDE LUMINANCE TOTAL BY NUMBER OF PIXELS SAMPLED
58
RETURN RESULT
60
END

FIG. 3

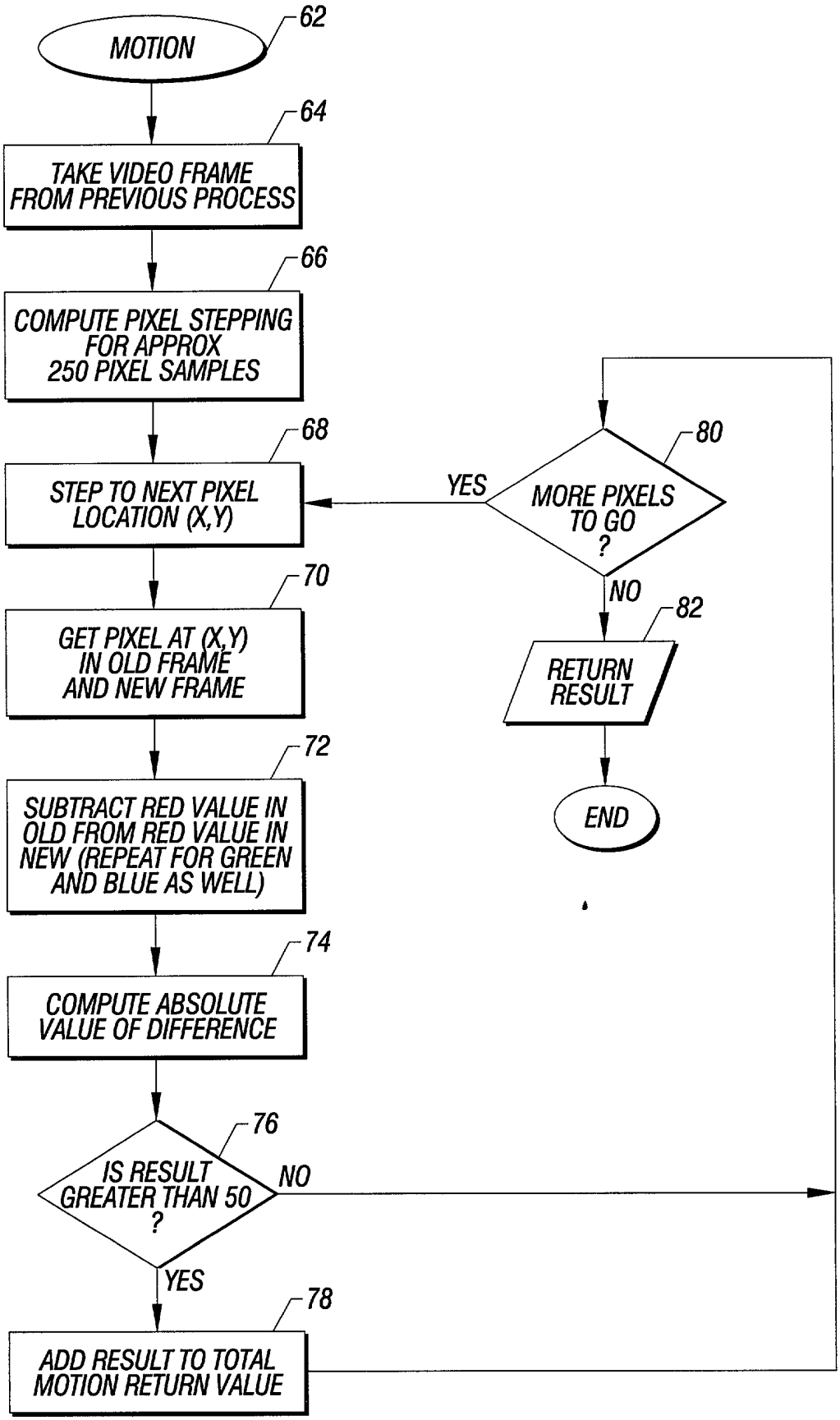
MOTION
62
TAKE VIDEO FRAME FROM PREVIOUS PROCESS
64
COMPUTE PIXEL STEPPING FOR APPROX 250 PIXEL SAMPLES
66
STEP TO NEXT PIXEL LOCATION (X,Y)
68
GET PIXEL AT (X,Y) IN OLD FRAME AND NEW FRAME
70
SUBTRACT RED VALUE IN OLD FROM RED VALUE IN NEW (REPEAT FOR GREEN AND BLUE AS WELL)
72
COMPUTE ABSOLUTE VALUE OF DIFFERENCE
74
IS RESULT GREATER THAN 50 ?
76
YES
NO
ADD RESULT TO TOTAL MOTION RETURN VALUE
78
MORE PIXELS TO GO ?
80
YES
NO
RETURN RESULT
82
END

FIG. 4

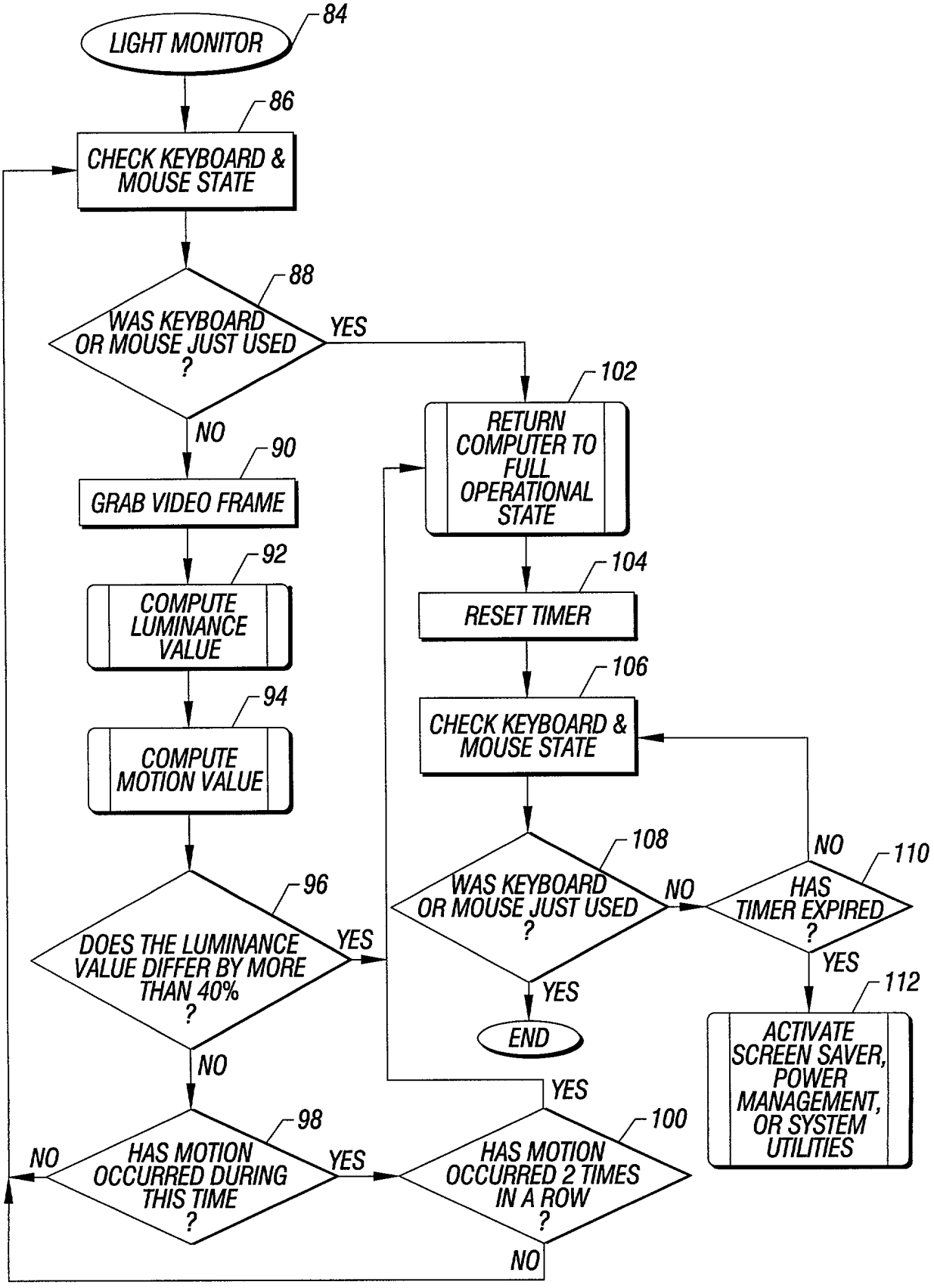
LIGHT MONITOR
84
CHECK KEYBOARD & MOUSE STATE
86
WAS KEYBOARD OR MOUSE JUST USED ?
88
YES
NO
GRAB VIDEO FRAME
90
COMPUTE LUMINANCE VALUE
92
COMPUTE MOTION VALUE
94
DOES THE LUMINANCE VALUE DIFFER BY MORE THAN 40% ?
96
YES
NO
HAS MOTION OCCURRED DURING THIS TIME ?
98
NO
YES
HAS MOTION OCCURRED 2 TIMES IN A ROW ?
100
NO
YES
RETURN COMPUTER TO FULL OPERATIONAL STATE
102
RESET TIMER
104
CHECK KEYBOARD & MOUSE STATE
106
WAS KEYBOARD OR MOUSE JUST USED ?
108
NO
YES
HAS TIMER EXPIRED ?
110
NO
YES
END
ACTIVATE SCREEN SAVER, POWER MANAGEMENT, OR SYSTEM UTILITIES
112

FIG. 5

Attorney's Docket No.: **INTL-0258-US (P7494)** PATENT

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

CONTROLLING PROCESSOR-BASED SYSTEMS USING A DIGITAL CAMERA

the specification of which

- [✓] is attached hereto.
- [ ] was filed on _____ as
  - United States Application Number _____
  - or PCT International Application Number _____
  - and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate Issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):			Priority Claimed	
Number	(Country)	(Day/Month/Year Filed)	Yes	No
Number	(Country)	(Day/Month/Year Filed)	Yes	No
Number	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of the United States provisional application(s) listed below:

(Application Number)	(Filing Date)
(Application Number)	(Filing Date)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Number)	Filing Date	(Status-patented, pending, abandoned)
(Application Number)	Filing Date	(Status-patented, pending, abandoned)

I hereby appoint Timothy N. Trop, Reg. No. 28,994; Fred G. Pruner, Jr., Reg. No. 40,779, Dan C. Hu, Reg. No. 40,025; Coe F. Miles, Reg. No. 38,559, and John R. Merkling, Reg. No. 31,716 my patent attorneys, of TROP, PRUNER, HU & MILES, P.C., with offices located at 8554 Katy Freeway, Ste. 100, Houston, TX 77024, telephone (713) 468-8880, and Joseph R. Bond, Reg. No. 36,458; Richard C. Calderwood, Reg. No. 35,468; Sean Fitzgerald, Reg. No. 32,027; David J. Kaplan, Reg. No. 41,105; Leo V. Novakoski, Reg. No. 37,198; Naomi Obinata, Reg. No. 39,320; Thomas C. Reynolds, Reg. No. 32,488; Steven P. Skabrat, Reg. No. 36,279; Howard A. Skaist, Reg. No. 36,008; Steven C. Stewart, Reg. No. 33,555; Raymond J. Werner, Reg. No. 34,752; and Charles K. Young, Reg. No. 39,425; my patent attorneys, of INTEL CORPORATION; with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Timothy N. Trop, TROP, PRUNER, HU & MILES, P.C., 8554 Katy Freeway, Ste. 100, Houston, TX 77024 and direct telephone calls to Timothy N. Trop, (713) 468-8880.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's Signature: Ranjit Menon	Date: Oct 26, 1999
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Inventor's Signature:	Date: 10/26/99
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